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COMPUTER-BASED INFORMATION SYSTEMS
IN THE UNITED STATES
DURING THE 1980s



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Mantell, Stan

Computer-Based Inforamtion
Systems in the U.S. During the
1990s





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Prepared For:
AGENCE DE L'INFORMATIQUE

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JUNE 1981

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I INTRODUCTION

I INTRODUCTION

- Computer-based information systems will expand in the 1980s to support word, graphics, video, voice and data processing - an integration of multiple disciplines under common programming control that INPUT calls "information technology systems."
- In the 1980s, IBM will be exposed to increasing competition for information technology systems business from giants like American Telephone & Telegraph, Exxon and the Japanese high-technology companies. This report examines the likely nature and thrust of this competition, which INPUT forecasts will be concentrated in the sectors of the market that address the raising of office productivity through automation. The stakes are substantial, as the market sectors concerned are growing at rates of 25% to 30% a year.
- It appears that this competition will be beneficial, not only to users but to IBM as well, in that the need to support increased accesses of computer data and of computer resources will require a significant expansion of central computing installations.
- Expansion of computer-based systems into hitherto nontraditional applications areas will require increasing transfer of applications development responsibility from systems department to using department personnel. Adverse demographic trends are resulting in an alarming decline in the proportion of skilled programmers to the number of general-purpose computers installed.

- The strong likelihood that hybrid data/text/image/voice processing systems will become the rule rather than the exception heightens the significance of subsystem interface considerations in total systems planning. The rapidity with which office automation systems are being introduced and obsoleted requires that systems planners be able to assure that subsystems can be attached to or disconnected from an information technology system with minimal impact to the rest of the system.

II BACKGROUND

II BACKGROUND

A. HOW THE MARKETPLACE WILL EVOLVE

I. GOVERNMENT POLICY

- The first of three major dependencies influencing the evolution of the marketplace for information technology systems in the 1981-1986 period is government policy in four significant areas: antitrust, telecommunications, energy and trade with Japan.
- The key antitrust issue, which is not likely to be ultimately resolved during the period, remains the 12-year-old U.S. Department of Justice action against IBM.
 - Recent developments in the government's antitrust suit against AT&T appear to have increased the likelihood of a negotiated settlement that will, for all practical purposes, leave AT&T intact while freeing the company from the onerous constraints of the 1956 consent agreement, especially the prohibition against AT&T's entering the field of data processing.
 - In view of this probable settlement, the government cannot avoid considering how the breakup of IBM that it is requesting would remain in the best interests of the public, as the fragments of a decimated IBM

would be at a serious competitive disadvantage relative to an unfettered AT&T.

- The trend toward fostering increased competition in the U.S. telecommunications field that began with the 1968 Carterfone decision is likely to continue, and the speed with which participants in this market bring new products and services to the marketplace probably will remain dependent to a large degree on the flexibility and responsiveness of U.S. federal and state regulatory agencies.
 - Outside North America, telecommunications services remain largely government monopolies run by each country's post office (the so-called "PTTs"), and it is virtually impossible to arrive at generalizations about their receptiveness to innovation.
 - However, national telecommunications systems currently under construction in less-developed countries, such as Saudi Arabia, Nigeria and Indonesia, will probably provide the most fertile breeding grounds for state-of-the-art innovation. Such countries have little or no pre-existing telecommunications plant to constrain system development with compatibility considerations.
- While the longer-term effects of U.S. oil price decontrol remain a matter of popular controversy, it seems clear that energy prices will remain high over the next five years. This factor will increasingly force large, geographically dispersed organizations to consider substituting audiovisual teleconferencing for business travel.
 - A study conducted by the Dartnell Institute of Business Research (DIBR) found that roughly half their respondents' business meetings could just as easily have accomplished their goals using teleconferencing rather than face-to-face contact by the participants.

- In the late 1970s NASA achieved a \$1 million saving in annual travel costs through the use of teleconferencing.
- Continued resistance on the part of the Japanese government to opening up protected Japanese markets may, at one extreme, trigger U.S. and European protectionist legislation in retaliation.
 - Despite chauvinistic rhetoric, the Japanese presence in U.S. and European high-technology markets has benefited the marketplace significantly; one need only consider the markets for steel, fuel-efficient automobiles, audiovisual equipment and plain paper copiers.
- Contrary to the conventional wisdom, Japan's Ministry of International Trade and Industry (MITI) does not carve up domestic Japanese markets and allocate the portions among domestic suppliers. Foreign vendors have been excluded from Japanese markets in the past to allow fledgling industries to achieve a viable status, but once the participants are past their start-up phases, MITI does not restrain domestic competition.
 - MITI has at least encouraged the sharing of research information among multiple competing high-technology firms, as in the recent effort to build state-of-the-art very large-scale integration (VLSI) components, when MITI distributed information to the five firms involved.
- Over the past ten years, on the other hand, MITI has forced Japanese textile manufacturers out of labor-intensive, low-value-added endeavors by allowing an increasing flood of imports from Korea and Southeast Asia.
- Nevertheless, the popular perception of MITI is that it pursues a policy of protectionism, and this erroneous perception could lead to retaliatory protectionism on the part of the U.S. and Europe.

2. TECHNOLOGY

- The second major dependency upon which the evolution of the marketplace rests is technology and the rate at which it will be inserted into commercial products.
- There is no reason to believe that, over the 1981-1986 period, electronics technology will not continue its secular trend of a 24% annual decline in price per unit of performance. The rate at which the benefits of this trend are reflected in product prices, however, remains a function of the various equipment vendors' product strategies and counter-strategies.
 - Exhibits II-1 through II-3 illustrate this point for IBM in terms of CPU, CPU memory and disk memory price/trends for 1970 to 1979.
 - Note, however, that the charts do not show consistent annual price declines of 24%. The proportion of non-electronic to electronic components varies with the type of unit, and comparable declines have not occurred in electrical and electromechanical technology.
- The outlook for satellite communications channel availability during the period has improved considerably over the past few months. The previous uncertainty hinged not on communications satellite technology but on U.S. launch capacity.
 - A 1977 Office of Management and Budget (OMB) study of commercial space payloads during the 1980s, initially criticized as being "overly optimistic and loaded," has been proven through hindsight to be accurate. About 85% of the initially forecast payloads through 1985 are now considered firm, with earnest money deposited to hold launch space, and over 50% of the 1986-1987 payloads are also firm.
- Serious slippage in the space shuttle schedule has forced a reassessment of U.S. launch capacity in the 1980s, which had been threatened with being

EXHIBIT II-1

IBM CPU PRICE TREND, 1970-1979

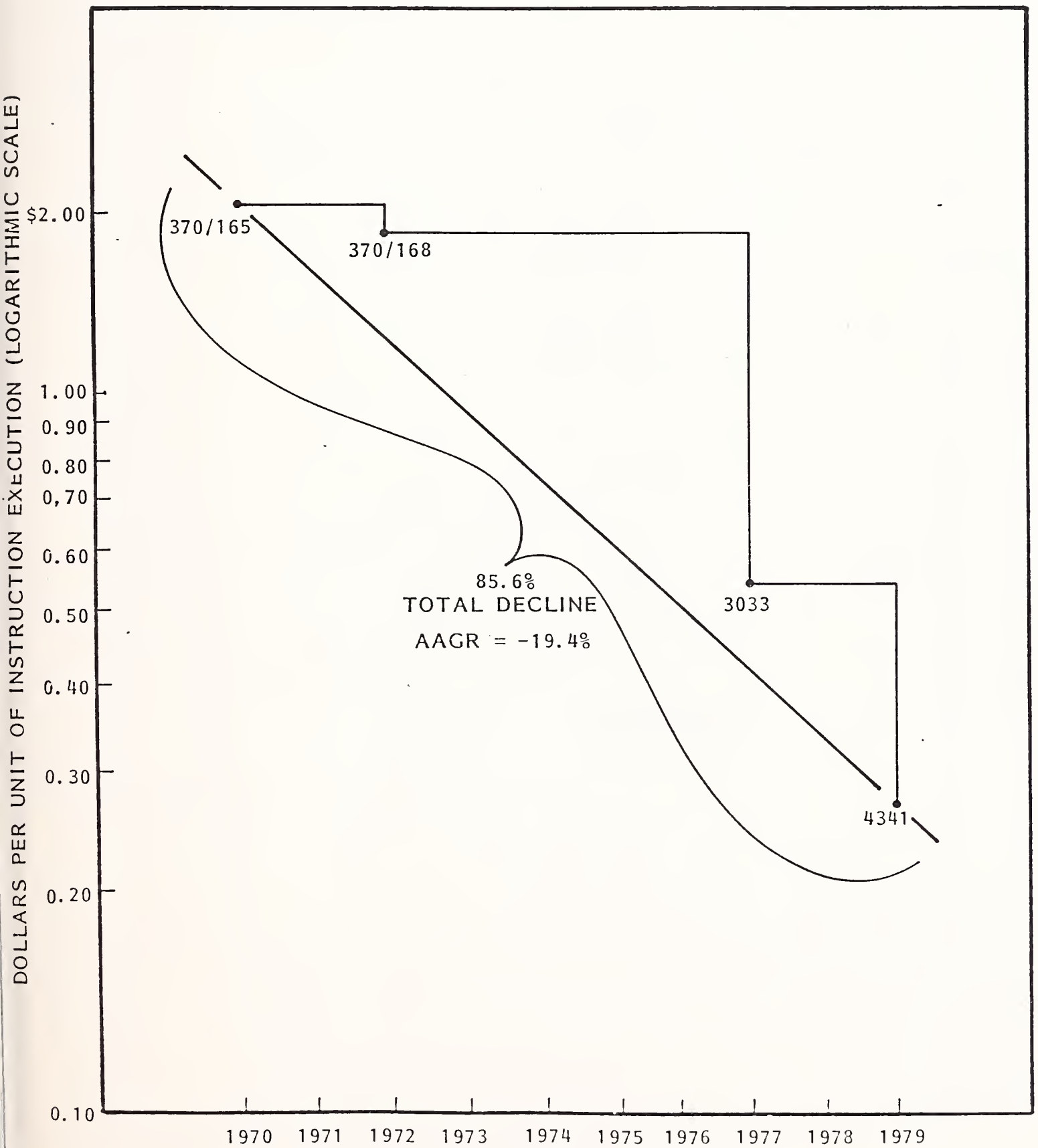


EXHIBIT II-2

IBM CPU MEMORY PRICE TREND, 1970-1979

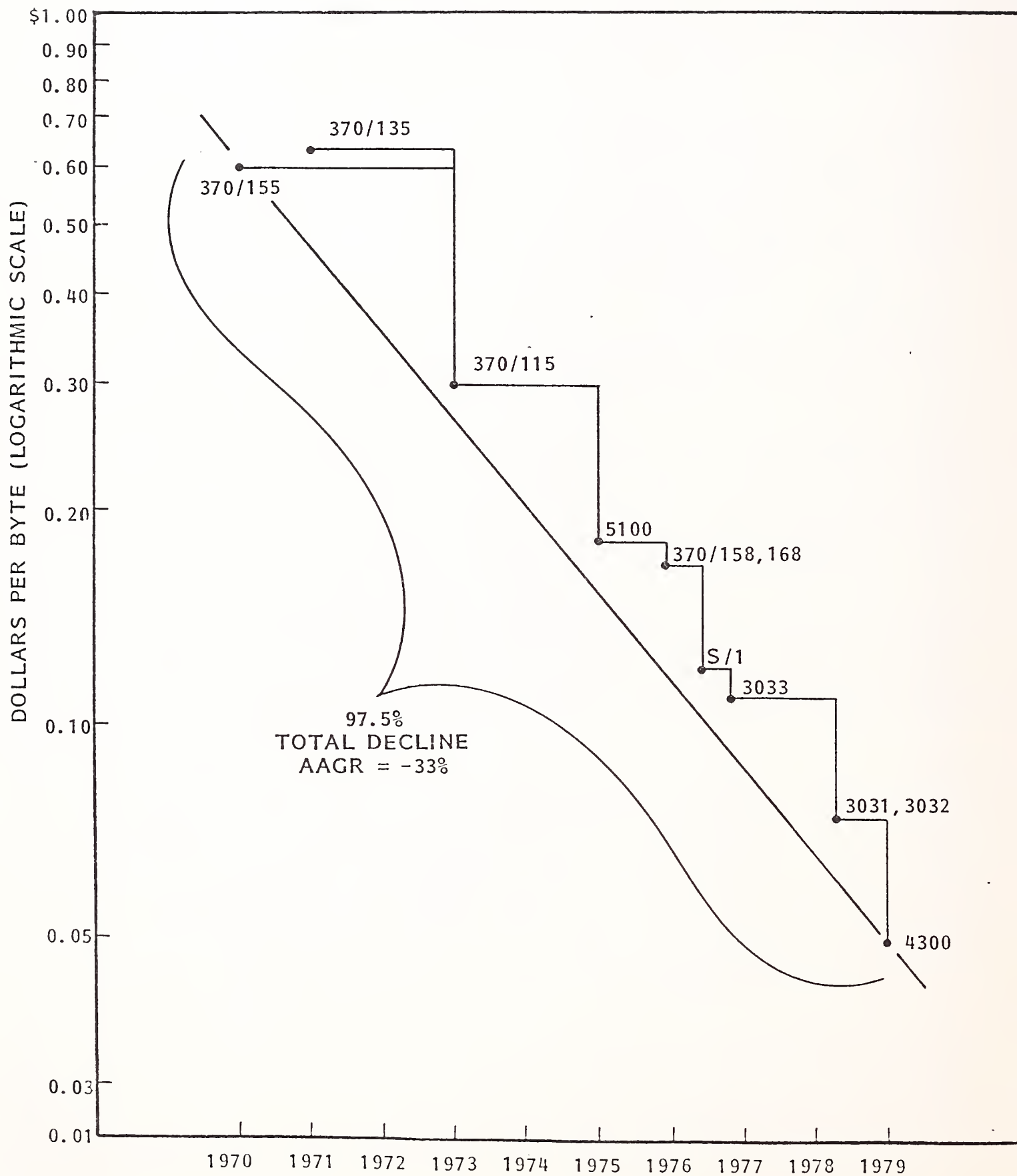
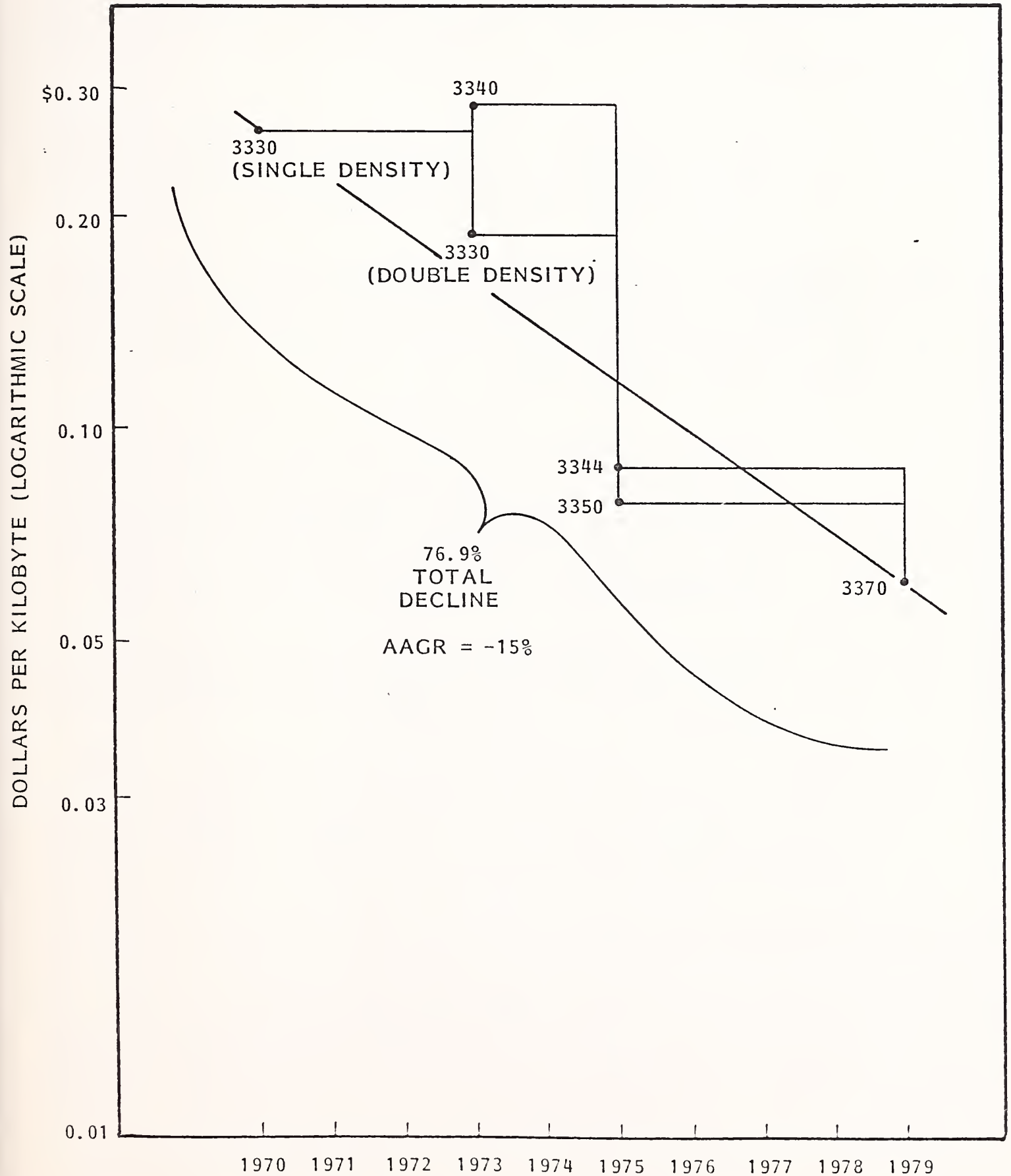


EXHIBIT II-3

IBM DISK MEMORY PRICE TREND, 1970-1979



outrun by the more than \$1 billion in growth expected in U.S. and international communications satellite markets. Over the past few months, plans to phase out expendable launch vehicles such as the McDonnell Douglas Delta launcher have been fully reversed, and launch capacity concerns have eased substantially.

- Moreover, NASA has begun to expand its Cape Canaveral complex and is currently examining the potential need for a seventh shuttle orbiter. See Exhibit II-4 for a listing of scheduled launchings, 1981-1985.
- A continued shift toward a higher proportion of digital transmission in the mix of traffic, arising both from computer-related demand and the digital nature of satellite-based transmission, will provide additional incentives to install digital terrestrial switching systems.
 - Telephone companies are already motivated to upgrade to digital central office switches because of demonstrable 64-to-1 reductions in cable requirements achievable when replacing an analog switch with a digital switch. In other words, use of a digital switch can increase the traffic-handling capacity of existing cables by a factor of up to 64.
 - Thus, the rate at which digital switching systems will be installed in the 1981-1986 period has a direct bearing on the rate at which line capacity will expand.
- The state of the capital and credit markets over the next five years will influence heavily the ability of the various telephone companies to finance purchases of digital switching systems.

3. PERSONNEL AVAILABILITY

- The third major dependency affecting the evolution of the marketplace was addressed by INPUT in its muliclient report, Improving The Productivity Of Systems And Software Implementation. The already highly visible shortage of

NASA

COMMERCIAL COMMUNICATIONS SATELLITE LAUNCH SCHEDULE, 1981-1985

1981	SATELLITE	OWNER/OPERATOR	REMARKS
	COMSTAR INTELSAT 5 F-1 SBS - B INTELSAT 5 F-3 RCA - D INTELSAT 5 F-4 RCA - C INTELSAT 5 F-5	COMSAT INTERNATIONAL CONSORTIUM SATELLITE BUSINESS SYSTEMS INTERNATIONAL CONSORTIUM RCA INTERNATIONAL CONSORTIUM RCA INTERNATIONAL CONSORTIUM	OVERSEAS COVERAGE - F-1 THRU F-15 SCHEDULED DOMESTIC - 480 Mbps CAPACITY SEE INTELSAT 5 F-1 ABOVE (NOTE: F-2 IS A BACKUP FOR F-1) SEE INTELSAT 5 F-1 ABOVE REPLACES RCA - C LOST IN SPACE IN 1980
1982	SATELLITE	OWNER/OPERATOR	REMARKS
	WESTAR - D INSAT TELESAT - E TELESAT - F WESTAR - 5 RCA - E ANOTHER INTELSAT POSSIBLE (SEE INTELSAT 5 F-1 ABOVE)	WESTERN UNION INDIA CANADA CANADA WESTERN UNION RCA INTERNATIONAL CONSORTIUM	
1983	SATELLITE	OWNER/OPERATOR	REMARKS
	PALAPI B-1 RCA - F TELESAT - G HCI - 1 AT&T - A INSAT 1B SPC - A	INDONESIA RCA CANADA HUGHES COMMUNICATIONS AT&T INDIA SOUTHERN PACIFIC COMMUNICATIONS	
1984	SATELLITE	OWNER/OPERATOR	REMARKS
	PALAPI B-2 RCA - G 2 G-STARS TELESAT - H AT&T - B AT&T - C 2 INTELSATS SPC - B HCI - C	INDONESIA RCA GTE CANADA AT&T AT&T INTERNATIONAL CONSORTIUM SOUTHERN PACIFIC COMMUNICATIONS HUGHES COMMUNICATIONS	
1985	SATELLITE	OWNER/OPERATOR	REMARKS
	ONE RCA AND 2 SPC SATELLITES		

NOTES: 1. SLIPPAGE IN SPACE SHUTTLE SCHEDULE HAS PROMPTED SOME OPERATORS TO PROCURE BACKUP
EXPENDABLE LAUNCH VEHICLES.
2. CAPACITY IS NOT DIRECTLY COMPARABLE TO TERRESTRIAL FACILITIES.

skilled manpower necessary to develop and maintain the programming systems required to support the information technology systems of the 1980s will continue to accelerate.

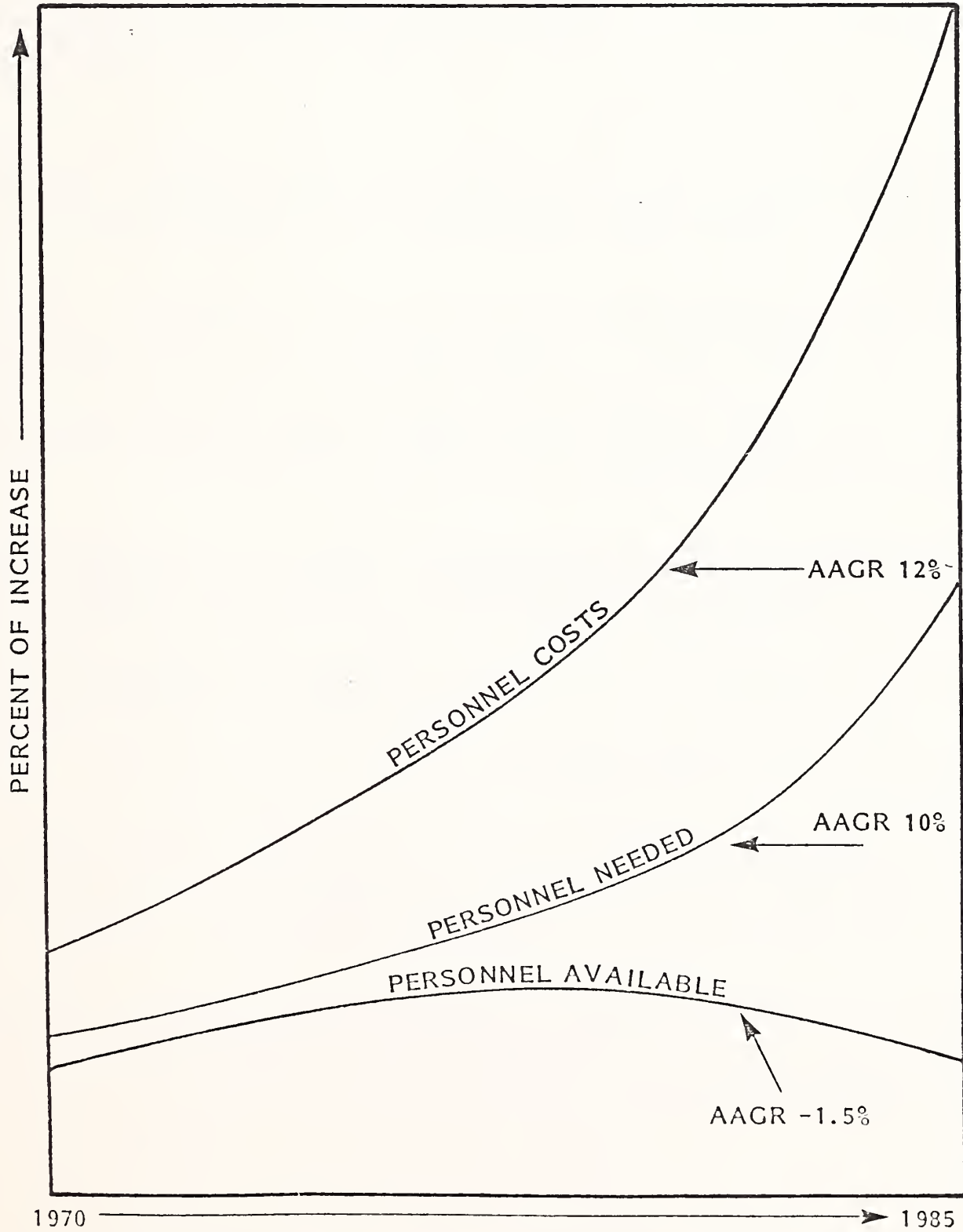
- As noted in Exhibit II-5, INPUT forecasts that industrywide personnel demand through 1985 will be rising at an average rate of 10% per year while the number of new entrants will be declining by up to 1.5% per year.
- Restated in terms of the ratio of programmers to general-purpose computers, this projection means that from a 1.5-to-1 ratio that existed in 1975, the proportion will decline to less than one-fourth of a programmer per general-purpose computer installed in 1985.
- The shrinkage in the supply of computer personnel in the 1980s may argue against the likelihood that the computer population will be growing as rapidly as forecast. However, the anticipated personnel shortage will not be limited to programmers, but will extend to all sectors of the economy.
- The 18- to 24-year age group is forecast to decline to 27.9 million by 1985, which is roughly 4% below the 1978 level.
- Computers will be needed to offset the resultant reduction in services provided by entry-level workers.

4. SUMMARY OF FACTORS

- Against the background of these policy, technology and demographic considerations, INPUT's most likely scenario of how the 1981-1986 marketplace for information technology systems will evolve depends to a large degree on the business environment that the policies of the Reagan administration will establish.

EXHIBIT II-5

ANTICIPATED PERSONNEL COSTS AND SHORTAGE



- Overall, this administration's tax policy appears committed to spurring investment in capital equipment to increase productivity.
- If the Reagan administration does not elect to seek a swifter resolution of the Department of Justice antitrust suit against IBM, the normal progress of litigation - including appeals - suggests that ultimate resolution of the case (i.e., by the Supreme Court of the United States) will not occur before 1985 at the earliest. Thus, a restructuring of IBM (should the government prevail) is unlikely during the period.
- Competition to provide digital telecommunications products and services will intensify and accelerate, to the ultimate benefit of the end user.
- The high price of energy will be conducive to increased use of teleconferencing. However, the extremely high demand on transmission capacity that full visual teleconferencing imposes will probably restrict the visual portion to still frames (e.g., charts, tables, graphs and pictures) in conjunction with a full audio hookup.
- Despite continued political agitation, it appears that the Reagan administration is philosophically opposed to trade barriers against Japanese competition. This competition, however, is likely to remain in those segments that play to Japanese strengths and are characterized by low-margin/high-volume manufacturing, mass distribution, and the availability of extensive applications software from third-party sources.
- Increased competition, as well as IBM's massive capital spending that has been very much in evidence over the past two years, points to an acceleration in the flow of new products serving the market.
- Increased defense spending will revitalize certain aspects of the U.S. space program, with favorable effects on private industry's ability to expand satellite capacity.

- The projected personnel shortage will remain acute.

B. PRIMARY COMPETITIVE ARENA: OFFICE AUTOMATION

- The most visible competition for the end user's dollars will be in office automation.
- Over the past decade, U.S. office costs have more than doubled, and currently represent about half of total corporate costs. Meanwhile, office productivity has not increased to any significantly meaningful extent.
 - The decline in the 18- to 24-year age group forecast for the 1980s will exacerbate office productivity.
 - Roughly 80% of current office operating expense is in managerial/professional costs, where automation thus far has had little impact.
- Equipment vendors have recognized the implications of these trends and have been devising various product strategies in an attempt to capitalize on them.

I. NETWORKING SUPPORT

- Standalone document preparation has proven to be fairly easy to automate, while other labor-intensive document handling functions - filing, retrieval, duplication and distribution - require a sophisticated data base and, in many cases, networking support that is beyond the technological and/or financial reach of all but the largest corporations.
- Some of the large vendors of office automation equipment have begun to take steps to provide the necessary data base and network support, on a public basis, to open up the market for their equipment among medium-sized and small firms.

- Notable examples of such activity include Satellite Business Systems' (SBS) Local Document Distribution (LDD) service; Xerox's Telecommunications Network (XTEN), the local-loop subset of which - known as Ethernet - is currently being installed; and American Telephone and Telegraph's (AT&T) Advanced Communications Service (ACS).
- Although these services are not yet uniformly and universally available, the intent is clear: to relieve the end user of various aspects of the task of developing the infrastructure required to support automation of the office.

2. MAN-MACHINE INTERFACES

- The impending demographic problem occasioned by the forecasted decline in the 18- to 24-year age group argues for increased competition in man-machine interfaces.
 - As the pool of clerical workers shrinks, executives and professionals will be increasingly forced to use terminals and other equipment.
- The observed disinclination on the part of executives to use a keyboard implies increasing use of touch-sensitive panels in conjunction with "menu selection" software for executives.
- The data entry interface remains keyboard driven, but Xerox is preparing an optical input feature for its 8010 Star professional/executive workstation introduced on April 27, 1981, which will enable a user to hold a document up to its screen to have the information read optically and entered into the system.
 - Xerox has been working on the problem of optically scanning a page and converting the scanned data into digitally encoded form since the days of "Project Zodiac" in the early 1970s.

- Although the optical input feature was not announced at the April 27 product introduction, Xerox stated that the 8010 Star system was the first of four related product introductions scheduled for 1981.
- If the optical input feature rumor is correct, Xerox has successfully solved the problem, and the industry is on the threshold of an exciting technological breakthrough in data entry.
- Bell Laboratories demonstrated an experimental voice synthesizer in 1974, and Threshold Technology, Inc. has developed a prototype voice-activated typewriter, but INPUT believes that voice input and output for information technology systems are unlikely during the 1981-1986 period.
- In certain military applications, a laser light beam mounted on a helmet can be directed to activate or deactivate a piece of equipment when the light beam is focused on a sensor. It is INPUT's opinion that activation of equipment using this line-of-sight technology may precede voice activation in the marketplace, but the utility of this technique remains highly conjectural at the present time.

3. TOTAL PACKAGE SOLUTIONS

- The personnel shortage seems likely to increase the proportion of product offerings aimed at providing packaged solutions to information technology problems, relative to those that supply tools to enable users to devise their own solutions.
- The "packaged solution" concept is more likely to surface in the marketplace for small computer systems and dedicated applications systems. Obviously, the convenience of the packages must be weighed against the exposure to quality control and maintainability risks.

- The "computer as tool" marketing concept will probably be restricted to the systems house market and to the market that supports very large complex systems.
- A new concept, that of the "packaged tool," is typified by the joint Intel-Digital Equipment support of Xerox's Ethernet.
 - Intel provides microprocessors, and Digital Equipment Corporation makes its networking expertise available, to equipment designers who wish to attach their products to an Ethernet loop.
- The use of such components appears to be concentrated in solving the problem of interfacing dissimilar systems from a variety of system vendors.
 - Quality control is much less of a problem than in the case of "packaged solution" systems, because the "packaged tool" addresses a much more tightly structured problem.

4. SERVICE AND SOFTWARE

- Service will remain a key competitive arena as information technology systems pervade more operational areas of a business. The penalty for failure of a system or subsystem could very well be disruption or paralysis of part or all of an organization's operations. Thus, reliability and service will be increasingly critical to the ability of a business to continue operating.
- Software's role as the linchpin of information technology systems, as well as the highly labor-intensive nature of its production, makes it the focal point of vendors' pricing and product strategies.
 - Unlike hardware, which will benefit from price/performance improvements, the production and maintenance of both systems and applications software will become increasingly costly components of information technology systems.

- IBM's software pricing practices undoubtedly will set the pattern for its competition, and thus software rentals will be the rule rather than the exception.

5. SUMMARY OF REQUIREMENTS

- In the 1981-1986 period, the competition in information technology will be most intense in office automation, primarily because office functions transcend public, institutional, and private market sector distinctions. The automation of these functions addresses the broadest information technology market available, thus offering the greatest potential reward.
- The reward for which the competitors are striving is the end user's expenditures to automate labor-intensive document handling functions, not necessarily after labor costs have exceeded the costs of automation, but possibly as soon as users recognize that demographic trends have begun to drive up the cost of skilled or semi-skilled labor.
- Besides the more obvious functions of intra- and intercompany mail, automated document handling will include interactive computer-based preparation of engineering drawings, blueprints, and schematics, as well as graphs, charts and other pictorial representations of numeric data.
 - These imply an expansion of terminal product technology beyond the current conventional hardcopy/CRT display combinations, to touch-sensitive panels, multifont optically scanned direct data entry, and color as well as black-and-white graphics.
 - The Xerox 8010 Star system lets the user create simple graphics from the keyboard and has the capability of converting numeric data tables to graphic form.

- Office automation products providing these functions will be offered on both a standalone and an integrated basis, and in component, subsystem, or total system form.
- Service and software will be even more critical to vendor selection because of increasing exposure of businesses to operational disruption upon the failure of either component. As information technology systems extend further into different areas of a business, end users will become increasingly aware that they use such systems to help run a business, and that their businesses do not exist to run data processing shops.

III IBM's MOST FORMIDABLE COMPETITORS:
THEIR STRENGTHS AND WEAKNESSES

III IBM's MOST FORMIDABLE COMPETITORS: THEIR STRENGTHS AND WEAKNESSES

A. OVERVIEW

- Because of its size, IBM's installed base of computers and office equipment remains the prime target of competitors' efforts. In recent years, the competitive successes of rapidly growing minicomputer, word processing and PCM (plug compatible mainframe) manufacturers have given rise to the perception on the part of industry watchers and investors that "Fortress IBM" is not invulnerable.
 - While IBM remains preeminent in the electric typewriter field, the IBM name is no longer synonymous with word processing.
 - Two years ago, Dictaphone edged out IBM in shipments of dictating equipment.
 - IBM's plain paper copier venture can hardly be viewed as an unqualified success, since Xerox has remained the dominant supplier.
 - The introduction of the IBM Series/I in 1976 did not appear to affect the minicomputer industry's high shipment gains in the intervening years.

- The viability of the Amdahl Corporation represented the ultimate in the PCMs penetration of IBM's customer base, as it seemed that not even central processors could be shielded from competitive displacement.
- Concern over IBM's ability to meet competition has been heightened by recent strategic moves on the part of large organizations, some of them larger than IBM, the reasoning being that, if IBM is vulnerable to competition from lesser upstarts, it should be more so vis-a-vis the giants. Among these giants are:
 - AT&T, with 1980 revenues of \$50.8 billion, almost twice IBM's comparable revenues of \$26.2 billion.
 - Exxon, which grossed \$110.4 billion in 1980, or 4.2 times as much as IBM.
 - "Japan, Inc.," a perception of a government-supported export alliance of information technology companies including Fujitsu, Hitachi, Nippon Electric, Sony, Matsushita, Canon, Ricoh and Sharp.
 - Xerox, with 1980 revenues of \$8.2 billion, whose Office Products Division offers Ethernet and related terminal products aimed specifically at automating information handling.
- From the IBM user's standpoint, the key issues raised by the concept of IBM under siege are:
 - The strategic implications of the possibility that systems acquisition throughout a corporation may not be coordinated. While potential user departments in a corporation may independently acquire local systems from IBM's competitors on the basis of their immediate availability, such acquisitions may raise serious control problems down the road.

- The degree of difficulty and the cost involved in integrating other vendors' systems into IBM-based information systems, which are difficult to assess in advance.
- The management and control problems associated with multi-vendor environments, which invoke highly emotional, not always rational arguments.
- The validity of the concerns raised cannot be addressed properly without an analysis of each competitor's likely product strategies during the 1980s. In the remainder of this section we examine each competitor's most probable product strategies and compare each in turn with IBM, in terms of each one's strengths and weaknesses in finance, technology, marketing, support and service, and software.
- Exhibit III-1 presents selected financial data for IBM and its major domestic competitors which are discussed in further detail below.

B. AT&T

- The latent reorganization announced by AT&T in August 1980, and scheduled to take effect March 1, 1982, will likely result in two major operating entities, namely, a "Core" organization that will continue to operate in a regulated environment, offering transmission services to users and resale vendors; and a Fully Separate Subsidiary (FSS), an unregulated business that will provide terminal equipment on a predominantly leased basis.
 - Exactly how Bell Laboratories and Western Electric will serve the two operating organizations is still being debated.
- The "Core" organization will compete directly with IBM's SBS subsidiary. In its promotional literature, SBS claims to be able to reduce corporate long-

EXHIBIT III-1

1980 COMPARATIVE FINANCIAL DATA

(\$ MILLION)												
	RE- VEN- UES	NET PRO- FITS	DIVIDENDS		CAP- ITAL SPEND- ING	R&D SPEND- ING	CAPITALIZATION					
			\$ MIL- LION	AS % OF PRO- FITS			\$ MIL- LION	% OF TO- TAL	% OF EQUI- TY	OTH- ER*		
IBM	\$ 26,213	\$3,562	\$2,008	56.4%	\$ 6,195	\$1,520	\$18,734	\$16,453	\$ 2,099	11.2%	12.8%	\$ 182
AT&T	50,791	6,080	3,770	62.0	17,301	419	93,610	49,448	41,255	44.1	83.4	2,907
EXXON	110,381	5,650	2,348	41.6	6,465	489	37,801	25,413	4,717	12.5	18.6	7,671
XEROX	8,197	619	237	38.3	1,328	434	5,108	3,625	898	17.6	24.8	585
DIGITAL EQUIPMENT**	2,368	250	-	-	210	186	2,188	1,652	***490	22.4	29.7	46
WANG LABORATORIES**	543	52	-	-	100	37	425	191	214	50.4	112.0	-

**"OTHER" INCLUDES MINORITY INTERESTS, DEFERRED INVESTMENT TAX CREDITS, PREFERRED STOCK, ETC.

**FISCAL YEARS ENDED JUNE 30, 1980.

***DIGITAL EQUIPMENT FORCED CONVERSION OF \$400 MILLION WORTH OF CONVERTIBLE DEBT IN JANUARY 1981.

distance rates by anywhere from 5% to 30%, depending on the size of the corporation and the extent of its long-distance toll traffic. Out of AT&T's reported \$50.8 billion in 1980 revenues, approximately \$6.05 billion (11.9% of the total) represented toll revenues from WATS service and private lines. It is for this market, particularly for the \$2 billion in private line revenue, that AT&T and SBS will be competing directly. SBS's stated revenue objective of \$1 billion by 1990 suggests that SBS intends to wrest some business away from AT&T.

- The FSS will be competing with IBM initially at the terminal level, primarily by means of the Dataspeed terminal product family, but the competition will probably be concentrated in the market for equipment supporting switched point-to-point terminals. An anticipated shift to a higher proportion of digital transmission traffic renders the outlook for modems unclear.
- Because of the unregulated environment in which the FSS will operate, it would be the prime vehicle to support AT&T's anticipated thrust into the data processing field.
 - Although AT&T has withdrawn ACS at least temporarily, ACS seems to provide the functional blueprint for probable AT&T offerings. Through ACS, AT&T would have relieved end users of the necessity of designing and maintaining computer-based networks and would have provided data conversion functions automatically when transmitting data between computer devices with dissimilar data structures.
 - Thus, ACS appears to reflect a philosophy according to which AT&T would:
 - Underwrite the development and maintenance of a desirable data processing/data transmission function that has wide appeal but is difficult to cost-justify by all except the largest organizations.

- Price the function on a per-transmission/per-bit basis to attract a larger customer base.
- The FSS organization will have other markets to serve in addition to information technology.
 - AT&T's 1980 revenues from service and equipment charges were \$19.0 billion, or 37.4% of total revenues. The FSS would have to address the protection of the related installed equipment base as one of its highest priorities.
 - Therefore, the FSS's research and development budget cannot be wholly devoted to information technology.
 - AT&T's R&D expenditures of \$419 million in 1980, plus an unknown amount on the part of Bell Laboratories - even if devoted entirely to information technology - are only slightly more than 25% of the comparable IBM figure of \$1.52 billion for the same year.
 - Western Electric, AT&T's manufacturing subsidiary, spent roughly \$770 million on R&D in 1980. INPUT believes that a significant proportion of this amount went toward the development of digital switches and related software. However, as Western Electric has 80% or more of the total domestic telephone equipment market, it may find itself more concerned with defending its position than expanding into new markets, at least for the next five years.
- AT&T's high debt-to-equity ratio (83.4%) and high dividend payout ratio (62%) suggest that the FSS's ability to finance a sharp boost in R&D expenditures to match IBM's level may be severely limited. Depending on how AT&T's assets will be divided between the "Core" and the FSS, the FSS may not be able to borrow external funds at favorable rates, and the FSS's internal rate of return may be insufficient to generate the necessary funds from operations.

- The FCC has indicated its approval for AT&T to boost its depreciation rates substantially and to expense certain costs that were formerly capitalized, in recognition of AT&T's need to recover capital costs more rapidly during periods of high inflation.
 - The faster rate of capital recovery should generally be favorable, as it increases cash flow considerably, thereby allowing AT&T (or its FSS subsidiary) greater flexibility for expansion into nonregulated businesses.
 - However, faster capital recovery reduces AT&T's rate base (and therefore its earnings), and the reduced need for outside funds may ease the pressure on local rate agencies to grant rate increases.
- INPUT therefore concludes that - given the long lead times required to bring major information technology products to market - despite AT&T's sizable revenues, its intermediate term FSS strategy will concentrate on the market segment it knows best, namely, the equipment market. An across-the-board competitive effort with IBM appears foolhardy at this juncture.
 - AT&T's FSS operation will probably concentrate on:
 - . Expanding the range of subscriber options to provide such features as automatic call forwarding, hard-copy alternatives to message answering services (perhaps a device that provides a sequential print-out of telephone numbers which have tried to call an unattended handset).
 - . A signaling option to notify a subscriber who is using the phone that he has an incoming call.
 - . An abbreviated dialing option.

- A conference call option to permit three subscribers to talk to each other at the same time.
 - A "listen-on-hold" option.
- These features are already available in various combinations on commercially marketed PBX systems offered by AT&T and by other vendors.
- Based upon the product philosophy inferable from ACS and the FSS's likely initial emphasis on the individual subscriber market, the FSS's most probable initial product offering in the information technology field will be a home computer available on a rental basis (probably at \$50 per month or less), attachable to the telephone network.
 - Such a home computer would be supported by a software library accessible through the network, perhaps on a per-access basis, and a public storage facility may be offered to enable households to record household data electronically.
 - The software library will probably include programs for household budgeting, tax preparation, electronic date books and the like.
 - The technology required to support this scenario is well within AT&T's power to provide, as are the related marketing, support, software and service resources.

C. EXXON

- Exxon's R&D expenditures, like AT&T's, are remarkably low as a percentage of total revenues. In 1980, R&D spending of \$489 million was less than half of 1% of consolidated sales of \$110.4 billion.

- However, a breakout of the figures for Exxon Enterprises shows that the parent company is committed to massive financial support of its information technology ventures. With 1980 revenues estimated at \$283 million, Exxon Enterprises' expenditures of \$79 million for R&D represented 28% of estimated sales (10% represents the upper limit for most information technology companies), and its capital spending of \$219 million was more than 75% of the level of sales.
- In 1980, Exxon's debt-to-equity ratio was 18.6%, and the company paid out 42% of its earnings in dividends to shareholders. Exxon therefore appears capable of sustaining massive investments in its high-technology subsidiaries from internal sources, and can conceivably raise an additional \$1.6 billion in long-term debt if necessary, before it reaches the 25% debt-to-equity ratio that investors consider to be normal leverage for an industrial corporation.
- Exxon appears to possess the technological expertise to address the office automation market.
 - Vydec supplies word processing equipment that can communicate with computers and other terminals.
 - QWIP's installed base of low-speed, low-cost telephone facsimile machines rose to over 55,000 worldwide in 1979.
 - According to Exxon's 1979 annual report, the QYX electronic typewriter was Exxon Enterprises' fastest growing venture in 1979.
 - ZILOG's Z-8000 microcomputer chip has gained significant market acceptance.
- Exxon's overall strategy of how Exxon Enterprises' subsidiaries will attack the information technology systems market is presently a matter of conjecture.

- ZILOG probably holds the key to interconnecting other products into an integrated information technology system.
- All Exxon's high-technology subsidiaries were acquisitions. Exxon's ability to coordinate their strategic thrust with that of the parent cannot be viewed as a foregone conclusion.
- A possible parallel that leaps to mind is Northern Telecom's 1979 acquisitions of Sycor and Data 100; it may be that the entrepreneurial mindset of the managements of these companies was at odds with the organizational structure of the parent.
 - Integration of Sycor and Data 100 into Northern Telecom Systems remains behind plan.
 - Northern Telecom's strategy for the 1980s centers on growth in digital switching systems, which are nothing more than general-purpose computers dedicated to a specific task (switching).
 - It would seem that, because of the essential similarity of their respective businesses, the integration of Sycor and Data 100 into Northern Telecom would have proceeded fairly smoothly.
- On the other hand, Exxon's primary business is oil. It remains to be seen whether, if push comes to shove, the priorities of the information technology market will have to yield to those of the oil business.

D. JAPAN, INC.

- Comparable financial data for the "Japan, Inc." group are difficult to compile, due to differences in financial reporting standards and the difficulty in placing a realistic dollar value on the research-sharing practice to which MITI is given.

However, qualitative analysis of past performance of Japanese competitors in the U.S. marketplace provides useful clues to how they might compete with IBM.

- Japan's technical prowess is not in dispute. It is amply demonstrated in the markets for steel, automobiles, television, hi-fi and stereo equipment, plain paper copiers, and, most recently, semiconductors.
- Nevertheless, Japanese ventures into the U.S. computer mainframe market have met with less than spectacular success.
 - Fujitsu, with a 32% interest in Amdahl, sells components to Amdahl but has no direct computer marketing effort. U.S. sales of Fujitsu's banking and retail terminals are conducted through a joint venture with TRW.
 - Hitachi sells IBM-compatible mainframes through National Semiconductor, but does not market Hitac systems in the U.S.
- "Japan, Inc.'s" marketing policy, as influenced by Japanese government policy conducted through MITI, appears to be oriented toward assuring that producers introduce state-of-the-art production facilities and adopt low-margin, high-volume strategies that benefit feeder sectors downstream.
 - Against this policy background, it seems that Japanese technology manufacture is biased toward commodity-like production, which is the antithesis of the customization that characterizes computer-based telecommunications systems.
 - In consequence, marketing, support, service and software strategies are geared less toward multivariant systems than they are toward commodity products. Therefore, extremely high reliability becomes the alternative to establishing a large support organization.

- Therefore, INPUT believes that Japanese competition in the information technology field over the next five years will be mostly in the small, standalone personal computer and convenience copier markets. These markets are ideally suited for Japanese strengths, including:
 - High-volume manufacturing.
 - High product reliability.
 - Mass marketing through distributor outlets.
 - Extensive availability of support, service, maintenance and software through third-party sources.

E. XEROX

- Ethernet and XTEN are clear indications of Xerox's competitive thrust in the field of office automation: Xerox intends to be a major factor in the field of graphics transmission systems, including the retrieval and formatting of data on request, for presentation in alphanumeric or graphic mode.
 - Ethernet is the local-loop subset of XTEN, and permits the transmission of documents among devices attached to the loop.
 - As conceived, XTEN is a store-and-forward graphic image switching system that would enable subscribers to disseminate documents in graphic form on a nationwide basis. XTEN's business would be conducted by a wholly-owned subsidiary that would be regulated as a domestic public common carrier.

- With Xerox's 1979 acquisition of WUI, Inc., the holding company that owns Western Union International, Xerox established its presence as an international common carrier.
 - Interconnection of a domestic carrier with WUI's overseas links would be trivial from a technological point of view.
- INPUT believes that, with the exception of the Xerox 2300 and 2600 convenience copiers, all Xerox copiers introduced since 1974 are potentially capable of being integrated into an Ethernet loop.
 - This is because every product from the 3400 to the 9700 incorporates some type of microprocessor control.
- Obviously, Xerox's 800 series word processing systems are also potentially attachable to an Ethernet loop.
- Thus, Xerox's installed base of copiers and word processing devices appears to give Xerox a formidable competitive advantage in the worldwide market of office automation that the company's financial figures do not reflect.
- Financially, Xerox is in excellent shape. Cash flow has been positive over the past several years, and the company's debt-to-equity ratio has declined from a high of 76.8% on September 30, 1975, to 24.8% by the 1980 year-end.
 - In 1977, Xerox had announced its intention to raise its dividend payout ratio to 50% by 1982, but inflationary pressures over the past few years have forced a reconsideration of this plan, and Xerox's management apparently now believes that the shareholders' best interests will be served if Xerox reinvests the bulk of its earnings in the business rather than paying it out to shareholders.

- The Xerox 8010 Star executive workstation is specifically aimed at the 80% of current office operating expense - management and professionals - that is in greatest need of productivity benefits through automation.
- Historically, Xerox has budgeted 5% to 6% of sales for research and development, and the beneficial effects of this level of R&D spending can be inferred from such products as the Xerox 9700 system. Under stored program control of a DEC PDP-11/34, the Xerox 9700 converts electronically encoded alphanumeric data into graphic format and prints the data at the rate of two 8½" by 11" report pages per second.
 - Depending on a number of factors, this could represent a print rate approaching 40,000 lines per minute.
 - Unlike competitive IBM and Honeywell page printing systems, the Xerox 9700:
 - Uses plain bond paper rather than continuous-form or coated paper.
 - Does not use physical forms as overlays but rather "draws" the forms from prestored encoded descriptions.
- INPUT believes that Xerox will, during the early part of the 1981-1986 period, be the dominant (if not the sole) supplier of optical-to-digital data entry devices and, through retrofits of interface modules to the third-generation copiers that now represent the bulk of Xerox's shipments worldwide, the largest supplier of graphic output devices.
- Xerox's sizable marketing and service force, which is already in place, will be adequate to support the "electronic mail" and other services that INPUT sees Xerox as capable of supplying with minimal incremental effort.

- The service organization, in particular, is well equipped to support the complex terminal equipment required by such services.
 - The Xerox 3400, 5000 and 9000 Series, as well as the Xerox 8200, are electronically controlled, with substantial self-diagnostic functions already announced.
 - Thus, the service force is already trained to support equipment with high electronic content.
- The software required to support Ethernet and XTEN services is, as noted earlier, a store-and-forward system with inquiry-response support for document titles. Therefore, system software does not require much in the way of exotic new programming, and XTEN should be well within Xerox's capabilities to install.
 - As originally proposed, the XTEN system was to be based upon several minicomputer-driven nodes, and therefore its development was not envisioned as requiring a massive infusion of capital.

F. DIGITAL EQUIPMENT CORPORATION

- Digital Equipment, with fiscal 1980 sales of \$2.4 billion, is the largest factor in the minicomputer industry. As is the case with other industry participants, DEC's R&D expenditures run at close to 10% of total sales because of the rapidity with which new technology is introduced.
- In recent years, DEC has reverted much more visibly to its initial strategy of supplying system modules. Compared with the hardware modules the company supplied 24 years ago, however, today's "modules" could consist of very powerful computer systems.

- DEC's marketing strategy, however, remains oriented toward selling pieces of systems rather than supplying a customer's major data processing system.
- As a supplier of equipment to end users, systems houses and original equipment manufacturers (OEMs), Digital offers a variety of software systems to support the needs of each category of customer.
- Thus, DEC appears likely to perform a major role as supplier of "packaged tools" for interfacing subsystems with each other in the emerging market for information technology systems.
- INPUT estimates that DEC can fund roughly 15-20% of annual growth from internally generated cash. As the company's growth rate has been in the 25-30% annual range, additional external funds have been required, but the company historically has not encountered any difficulty in selling additional equity either directly or through the sale of convertible debt.

G. WANG LABORATORIES

- Local networking capability is currently receiving top priority in Wang's R&D effort, as the company recognizes that the key to success in the office automation market is a systems approach integrating different disciplines - data, word, image and audio processing - in a form that is easy to use.
- The markets that Wang's products address presently have growth rates ranging from 25% to 35% and vary in estimated potential from \$250 million to \$25 billion.
- Wang's spectacular growth of the past two years, in excess of 60% annually, has not been trouble free, as the growth in Wang's installed base has outrun the company's ability to provide service.

- However, the company has taken a number of steps within the past six months aimed at improving service and reducing its service costs to somewhere around the breakeven point in its fiscal 1981 year ending June. (Service costs in fiscal 1980 were 130% of service revenues for that year.)
- The excellence of the operating system software of Wang's VS-80 computer should enable the recently introduced top-of-the-line VS-100 to replace the VS-80 as the company's best-selling product over the next two years.
- The VS-100 is a state-of-the-art upgrade of the VS-80, and has the processing power of an IBM 4341 or a DEC VAX 11/780.

IV HOW IBM WILL FARE AGAINST THESE COMPETITORS

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A. IBM's POSTURE

- INPUT believes that IBM may have committed a strategic error in the latter part of the 1970s by underestimating the elasticity of demand for data processing equipment. Overwhelming market response to the IBM 303X processors announced in March and October 1977 and to the IBM 4300 processors announced in January 1979 may have been outside of IBM's previous experience.
 - As orders for these products remained firm, IBM responded in a manner that can only be described as awesome.
 - Following 7-8% increases in plant capacity in 1977 and 1978, IBM undertook to expand capacity by more than 20% in 1979, completing construction of four million square feet in 1979 and had an additional 11 million square feet under construction at the end of 1979.
 - In 1980, another four million square feet were completed and eight million square feet were under construction at year-end.
- Capital spending in 1979 and 1980 amounted to more than \$12.5 billion, requiring IBM to supplement cash flow from operations with borrowings amounting to around \$1.8 billion.

- Nevertheless, IBM's capital structure remains conservative, as total long-term debt of \$2.1 billion at year-end 1980 was less than 13% of shareholders' equity.

● In June 1980, John R. Opel, IBM's chief executive officer, articulated IBM's goal "to be the most efficient designer and manufacturer, the most efficient marketer and the most efficient servicer of information products." The company's recognition of the elasticity of market demand, belated though it may appear from the perspective of hindsight, has given rise to a number of commitments made in the company's 1980 annual report which are supportive of IBM's stated goal, and which include:

- Heavy investment in "the several dozen key technologies that drive the information processing industry ahead." (In 1980, IBM's R&D expenditures amounted to \$1.52 billion, or 5.8% of revenues, about half of which was spent on software.)
- Improving the ease of use of IBM products, including improving software so that users will require less training in data processing.
- Making IBM products easier to install and service, including new diagnostic methods that assure maximum product availability.
- Very high-volume manufacturing wherever possible, in order to lower production costs and therefore keep prices down.
- Providing support, over time, to permit communication among the Office Products Division's (OPD) Displaywriter, the General Systems Division's (GSD) IBM 5520 Administrative System, and the Data Processing Division's (DPD) IBM 8100-based Distributed Office System.

- Clearly, IBM is not about to concede the market for office automation systems to its competitors, despite the probability that this arena will be the most competitive of the next five years.
- IBM is acknowledging that ease of use of hardware and software will probably rank among the most important vendor selection criteria, and is committing its resources to ease of use. However, in this regard, IBM's competitors have unique strengths, as noted in the preceding section of this report.
- Regardless of how the competition progresses for office automation systems, IBM stands to benefit from the resultant increased demand for computing power and data storage at central computing installations that is certain to occur as rising data accesses cause response times to deteriorate.
 - Analysis of the competitive thrusts of IBM's competitors suggests that their competition for this portion of information technology systems will be less intense than for user interfaces and transmission facilities.

B. THE COMPETITIVE ENVIRONMENT, 1981-1986

I. MAINFRAME ARCHITECTURE

- INPUT believes that the architecture of the IBM 3081 processor complex - a controlling 3081 processor and two dyadic 3082 processors - is predictive of the architecture of future complex IBM systems.
 - The rest of the so-called "H" series will consist of multiple-processor complexes capable of executing up to 20 million instructions per second (MIPS), as compared with the approximately 9-MIPS rating of the IBM 3081 complex.

- Performance improvements will be realized less from advanced circuitry than from packaging improvements and the effects of parallel CPU operations.
- MVS/SP with JES2 or JES3 will be the primary operating system of the 1980s, not only for the 3000 Series processors but for IBM 4341s and up as well, now that 4341s are available in 4-megabyte configurations.
- INPUT suspects that MVS/SP Release 2, scheduled for June 1981 delivery, combines a major rewrite of the interrupt handling and interrupt response portion of the Supervisor with microcode support (in the Processor Extension feature) to permit parallel processing of interrupts. In an I/O-bound environment, this would enhance the throughput of a multiprocessor system significantly (in the late 1960s, an experimental tightly coupled dual System/360 Model 65 complex achieved 2.5 times the throughput of a single Model 65 using this software concept).
- Complex network systems currently evolving will link multiple distributed IBM 4300 or IBM 8100 systems with multiprocessor-based central computing installations.

2. COMMUNICATIONS NETWORKS

- AT&T's Long Lines Division (which we assume will be part of AT&T's "Core" organization) and IBM's SBS subsidiary will be competing for the domestic long-haul private line transmission services required by such systems.
- AT&T has received the FCC's authorization to compete in overseas common carrier markets, but thus far neither AT&T nor WUI have given any indication of the type of computer-related service each intends to provide.

- Competition between AT&T and SBS will most likely be on a price basis. Whether AT&T will be able to reprice its services to compete effectively will depend on whether AT&T will be permitted to adjust its accounting and revalue its assets to effect an adjustment to its rate base.
- Besides the anticipated competition between IBM and AT&T for terminal products business, potential competition may emerge in the interconnect area, as IBM has marketed a computer-controlled voice switch in Europe.
- Xerox seems to have hedged its commitment to XTEN, the current status of which is unclear. XTEN probably would have been most evident as a high bandwidth satellite-based switched service, competitive to some degree with ACS. The ACS offering is also presently in limbo.
- Competition for local-loop networking will probably be most intense between IBM with its standard networking products, Xerox-DEC-Intel with Ethernet, and Wang.
 - This competition will probably be influenced by the specific office terminal product requirements of each application and by manpower skills and availability.

3. INTERFACES AND END USER PRODUCTS

- The high vacancy rate for skilled telecommunications analysts and programmers - currently close to 30% - suggests that users will be highly dependent on the software infrastructures that support local network and office automation systems.
 - In the mixed-vendor environment that is likely to ensue, the value of Digital Equipment products begins to loom large as a means of interconnecting multi-vendor systems and subsystems.

- The expansion of computer-based services into more operational areas of a business, coupled with the projected shortage of skilled computer manpower, will require that various using departments plan on developing in-house computer expertise at least adequate to the task of defining new applications, a subject to be addressed in later INPUT reports this year.
- The virtual inevitability of multi-vendor environments for complex systems will dictate the rising importance of monitoring the requirements for interfacing different vendors' products.
 - This may become, over time, a less critical problem than it presently seems, at least insofar as interfacing with IBM protocols is concerned.
 - The Intel-Digital Equipment venture in support of Xerox's Ethernet interface promises to be the forerunner of an increasingly important product set of "packaged tools" for system integration and subsystem interconnection.
 - Funds-transfer applications are already using "black box" chips to solve high-complexity interface problems, and INPUT expects this approach to spread to other applications and industries as well.

V IMPLICATIONS FOR INFORMATION TECHNOLOGY
SYSTEMS PLANNING

V IMPLICATIONS FOR INFORMATION TECHNOLOGY SYSTEMS PLANNING

A. ALTERNATIVES AND CONSTRAINTS

- Strategic plans for integrating office automation systems into corporate information technology systems must explicitly recognize that, since no single vendor is likely to dominate any segment of the market, the multi-vendor environment that the user faces will require centralized contract administration.
- Integration of office systems will increase demands on distributed and central processing site resources. Failure to accurately measure the impact of this demand can result in serious degradation of higher priority tasks, to the extent that unanticipated additional shifts may have to be scheduled.
 - Traffic projections should be as accurate as possible. Inadequate processing resources will result in response times that may be so poor as to discourage use of the system. Worse yet, unacceptably lengthy response times could engender permanent hostility on the part of those who would benefit most from the system.
 - Studies have shown that serious performance degradation occurs when resource utilization exceeds 85%. Therefore, central installation resource planning should allow for at least a 15% capacity cushion.

- Pilot tests, limited perhaps to a small control sample of using departments, should be conducted over a sufficient span of time to establish the validity of estimated versus actual accesses to data.
- Thorough analyses of existing information flows may provide only a partial indication of the actual load on an automated system. For example, the ability to refer to a display screen may, in some cases, eliminate the need for producing multiple copies of a document, but concurrently increase system traffic by requiring or encouraging more system accesses than the number of hard copies eliminated.
- Networking strategies and acquisition plans for hardware to support telecommunications will require a thorough review each time an incremental subsystem is integrated into a corporate information technology system.
 - As satellite transmission capacity expands over the next several years, the economics of private line links are sure to change.
 - SBS will probably set the marketing pattern for other vendors. Currently two separately priced types of service offerings are planned, namely, private service with variable capacity provided on demand, and transmission service on an as-available basis.
 - Unlike terrestrial private line service, which requires the lease of fixed transmission channels regardless of the level of capacity utilization, satellite-based transmission technology permits equivalent dedicated service while producing substantial economies of scale because capacity is shared.
 - The all-digital nature of satellite transmission technology will render modems redundant in some cases.

- Depending on transmission volumes, cellular radio techniques and the use of cable may be more efficient and more cost-effective than existing local loop distribution techniques.
- Integration of voice and data transmission (including visual data) will alter the economics of private branch exchanges (PBXs) and other interconnect equipment at network nodes, when the maintenance of two separate sets of lines - one for voice and one or more for information technology equipment - eventually becomes impractical.
- The management implication of the eventual convergence of voice and data communications within an organization (or locations of that organization) is that corporate accountability for both types must reside in one single office.
 - If the manager responsible for procurement of communications equipment and services to support information systems is not the same person responsible for voice equipment and services, they should both report to the same executive to insure that procurement is consistent and coherent.
- While there is obvious merit in standardizing terminals throughout an organization, the point of acquiring devices for automating office functions is to encourage their use in order to increase office productivity.
- Keyboard devices can be introduced with little difficulty at workstations used by clerical and some professional personnel. However, other professional and executive personnel can react unfavorably to the use of a keyboard, and such a reaction may discourage use of the device.
 - The use of computer business games of moderate difficulty can be advantageous in encouraging familiarity with keyboard layouts, procedures and conventions.

- Executive workstations should have controls and interfaces that are easy to learn and easy to use.
 - Special attention must be paid to simplicity of use when developing "user-friendly" software to support such workstations: complexity must not be confused with complication (a fully featured automobile is a complex piece of machinery, but is not complicated to use).
 - Where possible, an industrial psychologist's aid should be solicited in structuring the interaction between the system and the executive user.
- The projected shortage of skilled programmers and analysts will require prospective on-line users to assume an increasing proportion of the burden of designing and implementing new applications.
- In this environment, making very high-level, non-procedural languages available to user department analysts can reduce the development of new applications to a matter of hours. Although many of these tools are relatively profligate with CPU resources, their advantage is that the definition and checkout of processing logic is extremely rapid.
 - A moderately skilled user can develop a fairly complex system producing recognizable output within hours or days, as compared with weeks or months using a conventional, procedural development language.
- The resulting system can then be turned over to the systems programming department for translation into a more resource-efficient language for operational purposes. This technique virtually eliminates any ambiguity in conveying user requirements to the systems programming department.
 - Changes to such a system can be implemented in a matter of minutes, and before the system has been converted into operational form the high-level system will be available as an interim product.

- While most office system and subsystem developers will continue to design IBM compatibility into their products, the proper interfacing of multiple vendors' products with corporate computing resources remains the user's concern today.
 - It is in this interfacing context that the concept of "packaged tools" will increase in importance over the next several years.
 - The governing principle is that subsystems should be attachable to, or detachable from, the total system in the "cleanest" possible fashion, so that the integrity of the system is not disturbed when subsystems are attached or detached.
 - Minicomputer- and microcomputer-based packages seem to offer the best solution for the interface problem.

B. SUMMARY

- In the 1981-1986 period, IBM will experience continuing and intensifying competitive pressure from AT&T, Japanese high-technology companies, and rapidly growing U.S.-based firms for portions of corporatewide information technology systems.
- This competition will be most visible in the arena of the automated office.
- Increasing acceptance of Japanese products at the local office level appears highly probable over the next several years. Such products will include facsimile transceivers, small mini- or microcomputer-based systems that address extremely structured business applications, and other products that do not depend upon cultural specifics for their proper operation. INPUT believes that an expanding Japanese presence in the domestic market will pressure domestic and European suppliers to focus their development efforts on

price/performance improvements on a continuing basis, to the ultimate benefit of the end user.

- The unique strengths of IBM's competitors virtually assure that information technology systems will be complex multi-vendor systems.
- Managers of information technology systems should be putting plans in place today for integrating office and other information subsystems into corporate data processing systems. While INPUT is not advocating centralization of all corporate information processing, both centralized and decentralized data processing systems will require interfacing non-IBM equipment and subsystems with IBM computers. INPUT believes that users should be continually addressing the strategic and tactical exigencies of this interfacing requirement.
- IBM will benefit from the competitive environment in that increased demands on central or distributed computing and data resources will require expansion of both to insure that reasonable response times are maintained.
- Users will benefit as competition forces all participants to improve the cost-effectiveness and ease of use of their product offerings.
- Management of information technology systems will become more complex, with vendor relationships, subsystem interfacing, and shortage of skilled personnel giving rise to the major management challenges of the next five years.
- Forward-looking information technology systems planners will factor these relationships into current plans, and begin to develop resources to provide the user training and coordination that will be required.

